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some has yet been obtained that contains both that factor and any mutant factor within its "sphere of influence."

Backcross tests have shown that males of all the above types with respect to C_{IIl} and C_{IIr} resemble "normal" males in giving no crossovers at all.

Included in the above tables are a considerable number of data involving three or more loci at once; and these agree with the table in showing clearly that the linear order of the factors established for the usual second chromosome is unchanged by the factors under discussion. The amount of crossing over is altered, often markedly, and not usually proportionately in different regions; but the factors keep their same sequence. This result serves to emphasize the importance of considering the distances on chromosome maps as only diagrammatic, not as representing actually proportionate distances between the genes, although actual distance is evidently an important factor influencing the end result. It does not, I think, in any way weaken the case for the chromosome hypothesis, but merely shows, together with the results of Bridges[5] (1915) and Plough[6] (1917), that any chromosome map is available for purposes of numerical prediction only when the conditions under which it was made are duplicated.

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[1] Some of the early results were reported at the 1913 meeting of the American Naturalists, and brief references have been published by me (1915) and by Muller (1916).

[2] Much of this data has not hitherto been published. It has been collected mainly by Dr. C. B. Bridges, to whom I am indebted for permission to use it.

[3] Muller, H. J., *Amer. Nat., Lancaster, Pa.*, **50**, 1916, (193, 284, 350, 421).

[4] Sturtevant, A. H., *Zs. Abst. Vererb.*, **13**, 1915, (234).

[5] Bridges, C. B., *J. Exp. Zool., Wistar Inst. Philadelphia*, **19**, 1915, (1).

[6] Plough, H. H., these PROCEEDINGS, **3**, 1917, (553–555).

FURTHER EVIDENCE ON THE CONCENTRATION OF THE STARS TOWARD THE GALAXY

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In a previous communication[1] attention was directed to the striking difference in the results for the distribution of the stars with respect to the galactic plane found by Kapteyn[2] and by Chapman and Melotte.[3] An analysis of the counts of stars on photographs of 88 Selected Areas, made at Mount Wilson with the 60-inch reflector, gave preliminary values for the variation in the totals to magnitude 17.5 which agree well with those of Kapteyn.

Further confirmatory evidence of the large value of the galactic condensation for the faint stars, which is so striking a feature of Kapteyn's conclusions, is available from two different sources. The first is a series of counts made at Groningen on photographs of 54 Selected Areas taken with the Bruce telescope of the Harvard station at Arequipa in Peru. The results for these including 127,315 stars, are given by Kapteyn in his *First and Second Reports on the Progress of the Plan of Selected Areas*.[4] The second source of data for a comparison is the collection of counts recently published by Turner for nearly 600,000 stars in zones of the *Astrographic Catalogue*.[5]

The durchmusterung photographs of the southern Selected Areas extend from +62° to −76° galactic latitude, and are well distributed throughout this interval. The exposure time was two hours. We assume that the different plates are comparable, in limiting magnitude, and a reference to Professor Kapteyn's tabulation[6] indicates that the agreement in this particular is satisfactory. The calculated limits of brightness given by him show considerable irregularity, but it should be noted that these have been derived from the observed density in each field, and are thus affected by local variations in the distribution of the stars, as well as by changes in atmospheric transparency and in the photographic conditions of exposure and development. For example, area No. 110, galactic latitude +1°, lies between the two branches of the Milky Way, and is known to include an abnormally small number of stars. This accounts for the unusually bright limit of 13.2 given by Kapteyn.

The photographs of areas in southern latitudes are richer in stars than those north of the Galaxy; but since the evidence from other sources as to the reality of this difference is conflicting, no distinction has been made between northern and southern latitudes in forming the mean curve connecting latitude with stellar density (number of stars per square degree to the limiting magnitude m, denoted by N_m).

After the counts had been arranged in the order of increasing latitude, overlapping means for groups of ten areas were formed, with the results shown in the first two columns of table 1. These define a smooth curve whose ordinates and corresponding abscissae for equidistant intervals are in the third and fourth columns of the table. The value in parentheses is an extrapolation. The fifth column contains the densities from Kapteyn's table in *Groningen Publication*, No. 18, p. 54, for magnitude 16.0, which is adopted as the mean limit for the whole series of plates. In the column following are the densities from the Mount Wilson photographs of 88 northern Selected Areas. These are the values given in these PROCEEDINGS, 3, 1917, 219, after the application of a correction of −0.10 to the logarithms to reduce them to the limiting magnitude of the durchmusterung plates.

The significant feature of the table is the relation between the three series of results shown by the differences in the last two columns. These reveal no important systematic effect and show that the increase in stellar density with decreasing latitude is substantially the same for all three investigations. The differences MW–DM are noteworthy in that all of the Mount Wilson photographs are of regions on or north of the celestial equator, while the durchmusterung areas are on or south of the equator, with only seven regions in common.

The average value for the ratio of the number of stars at 5° latitude to the number at 80° is 23, with deviations of −2, +4, and −2 for DM, Kapteyn, and MW, respectively. This result refers to magnitude 16.0 on the scale of *Groningen Publication* No. 18. On the international photographic scale the limit would be approximately 17.0.

The counts for the Astrographic zones, which constitute a very important collection of data, have been discussed with detail in an article that will appear in the *Astrophysical Journal.* The salient features only need be touched upon here. The zones are ten in number, each 2° wide, and well distributed in declination from +62° to −65°. The counts extend throughout the entire 24 hours of right ascension, so that each zone includes a wide range of galactic latitude. We have here, for each hour of right ascension, not only the total number of stars to the faintest limit of the *Catalogue,* but also the totals to at least one, and usually two, other limits from one to three magnitudes brighter. We assume that each limit is constant for any given zone; although there are obvious irregularities, their influence is pretty thoroughly eliminated by the method of discussion, and it is improbable that the mean distribution is affected to any important degree.

A curve connecting latitude and density was drawn, just as in the case of the durchmusterung counts above, for each separate limit of each zone. From these curves were read the stellar densities for each 10° latitude. With these and their respective latitudes as arguments, corresponding magnitudes were interpolated from Kapteyn's distribution table in *Groningen Publication* No. 18. The mean of the magnitudes thus found for any curve was adopted as the limiting magnitude for that curve and for the series of counts to which it corresponds. The process is exactly that described in these PROCEEDINGS, 3, 1917, 217, and there used for the determination of the limiting magnitude, on the scale of Kapteyn's table, of the Mount Wilson photographs of the Selected Areas.

The next step involved the segregation of the data for equidistant values of galactic latitude. The 0° ordinate for each of the original curves was plotted against the limiting magnitude just found for the curve to which it belongs. These points define a new curve expressing the variation of stellar density with magnitude for regions in 0° latitude. Similar curves were also derived for 10°, 20°, etc., by plotting the appropriate ordinates of the original curves against their limiting magnitudes as before. From the new curves were read the densities corresponding to each half-magnitude interval from 8.5 to 12.5. The results, when tabulated, constitute a distribution table analogous to that of Kapteyn, though restricted in its range of brightness.

TABLE 1

COMPARISON OF DURCHMUSTERUNG RESULTS WITH KAPTEYN AND MOUNT WILSON

MEAN LATITUDE	OBSERVED LOG N_m	GALACTIC LATITUDE	LOG N_m			KAPTEYN MINUS DM	MW MINUS DM
			DM	Kapteyn	MW		
3°	3.99	5°	3.97	4.04	4.03	+0.07	+0.05
10	3.90	15	3.79	3.74	3.76	−0.05	−0.03
16	3.75	25	3.50	3.47	3.43	−0.03	−0.07
23	3.63	35	3.22	3.23	3.16	+0.01	−0.06
30	3.32	45	3.00	3.04	3.00	+0.04	0.00
37	3.17	55	2.84	2.89	2.88	+0.05	+0.04
47	2.98	65	2.74	2.74	2.79	0.00	+0.05
60	2.79	80	(2.65)	2.60	2.69	(−0.05)	(+0.04)

TABLE 2

DIFFERENCES IN LOG N_m FROM ASTROGRAPHIC ZONES AND FROM KAPTEYN'S TABLE OF DISTRIBUTION

(Unit = 0.01)

MAGNITUDE	GALACTIC LATITUDE								
	0°	10°	20°	30°	40°	50°	60°	70°	80°
8.5	−3	0	0	+2	+2	+1	+1	+1	0
9.0	−3	0	0	+1	0	−2	−2	−1	−2
9.5	−1	+1	+3	+2	0	−3	−3	−3	−1
10.0	0	+1	+3	+3	0	−2	−3	−2	−1
10.5	−1	+1	+4	+3	0	−2	−4	−2	+1
11.0	−3	0	+4	+3	−1	−2	−3	−2	−1
11.5	−3	−1	+4	+4	+1	−1	−1	0	−1
12.0	−4	−1	+3	+4	+1	0	0	+1	−2
12.5	−5	−1	+4	+5	+3	+2	+2	+1	−1

Our interest is naturally in the agreement of these two tables. Their differences (Astrographic zones *minus* Kapteyn), in units of the second decimal, are shown in table 2. Though more or less systematic, the deviations are very small—in most cases within the uncertainty which necessarily affects the discussion of the data. To this extent, therefore, we may look upon them as supplying a very satisfactory confirmation of Kapteyn's results. This fact is further illustrated by the following series of values for the galactic condensation (ratio of number of stars at 5° to number at 80°).

Limiting Magnitude	8.5	9.5	10.5	11.5	12.5	16.0
Kapteyn	2.6	3.1	3.8	4.9	6.7	27
Astrographic Zones	2.4	3.2	3.8	4.7	6.2	....
Arequipa, Selected Areas		...	....	....	....	21
Mt. Wilson, Selected Areas		...	....	....	....	21

It is important to note that the use of Kapteyn's density table for the determination of the limiting magnitudes of the counts has not artificially forced an agreement with his values of the galactic concentration. The use of a limit thus derived for any zone in no wise affects the rate at which the density observed within that zone increases with decreasing latitude. The results are referred to Kapteyn's scale of magnitudes, but this influences only indirectly the value of the condensation for any specified limit.

A comparison of the counts for the different zones with the mean distribution table whose derivation has been outlined reveals large deviations in individual cases. To what extent these represent local variations in stellar density cannot now be determined. Professor Turner has been led to believe[7] that the Astrographic data give evidence of a spiral of obscuration encircling the sky, in which the ratio of the number of faint stars to bright stars is abnormally low. But his discussion seems not to include the influence of the increase in galactic condensation with increasing magnitude, which appears so clearly in the numbers appended to the preceding paragraph. When this has been duly allowed for, the fluctuations in the ratio of faint stars to bright stars assume an accidental character; doubtless they correspond in part to actual variations in density, but differences in observing conditions must also have contributed much in producing the irregularities.

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[1] Seares, F. H., these PROCEEDINGS, **3**, 1917, (217–222).

[2] Kapteyn, J. C., *Groningen, Pub. Astr. Lab.*, No. 18, 1908, (1–54).

[3] Chapman, B. A., and Melotte, P. J., *London, Mem. R. Astr. Soc.*, **60**, 1914, (145–173).

[4] Published by the Astronomical Laboratory at Groningen, 1911, (1–34).

[5] Turner, H. H., Numerous articles in *London, Mon. Not. R. Astr. Soc.*, **72, 75, 76, 77**, 1909–1916.

[6] Kapteyn, J. C., *First and Second Reports, Groningen*, 1911, (1–34), p. 15.

[7] Turner, H. H., London, *Mon. Not. R. Astr. Soc.*, **76**, 1915, (149–157), p. 152.